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Ist IDAVic Dark Sky Symposium

Held on the 2nd April 2018 at The Ballarat Municipal Observatory and Museum, Victoria, Australia

The Program is in the Appendix.

Twenty two people attended the inaugural meeting which listed a fine collection of speakers and range of topics. The forum provided a wealth of information and excellent opportunities to network, to learn best practice and to consider the best options for influencing government. This report is a crystallisation of the key themes presented, the outcomes and strategies likely to influence government in lighting awareness. However, we must avoid the argument that astronomers need quality skies for their pursuit as it does not carry much weight with governments.

Our emphasis should be on preserving the “night” sky rather than “dark” sky because of the general negative connotations of the word “dark” – sinister, dangerous, etc. In all populated locations dark skies, as traditionally defined, are not achievable.

An important part to preserving the night sky is regular monitoring of sky quality. The data collected provides a scientific basis for the next step - site selection, IDA accreditation, getting the local government involved, etc. Sky Quality meters (SQM) are inexpensive and the value of regular use over the long term (with accompanying photographs of the sky recommended as additional evidence) was evident and encouraged.

Measurements need to be carried out in the surrounding areas to better assess how light there impacts sky quality in the central location. Such a strategy is being applied at, and around, the Ballarat Municipal Observatory and the data have been effective in enhancing community awareness of the effects of lights at night. Changes to lighting conditions in the area were clearly correlated with changes in SQM.

The problem of checking SQM calibration over time is a problem and was not directly discussed. The River Murray Dark Sky Reserve team recognised the potential problem by using four meters, taking the meter with the "central" reading as “Gold Standard” SQM, and adjusting the readings from the other three meters with +/- offsets to match the “Gold Standard”. They also used all sky images to provide complementary data for assessing cloud conditions. Five years of monthly VIIRS data were also used to assess changes in light sources, and there is a continuing program of collecting high resolution cloud images from the Himawari Satellite with plans to use these for generating real life cloud statistics over the Reserve. They hope to receive (gold-level) designation from IDA soon.

In one case SQM measurements taken over a considerable time in the light polluted northern suburbs of Melbourne area suggested that sky quality had improved yet the perception by deep sky observers was that nebulae were more difficult to see. A plausible explanation was that the widespread adoption of blue-rich LEDs over the years had created skyglow richer in blue wavelengths which overly affected the observer’s ability to perceive the detail in low contrast celestial objects (note the recommendation to take photos as supplementary evidence above).

Citizen scientists can play a valuable role in night sky monitoring and programs exist to monitor light pollution globally. Australia is poorly represented in providing data to these programs. Data are valuable in correlating satellite data and images taken from ISS and can used to formulate policy on lighting.

On the Internet, among others, is the “Night Sky Atlas” an interactive world light pollution map which uses NOAA/EOG VIIRS/DMSP satellite data <https://www.lightpollutionmap.info/>

Readily available citizen science projects include mobile phone apps for measuring sky brightness such as, “Globe at Night”, “Dark Sky Meter” (under development, not available at present), “Loss of the Night”, “Globe Observer”. Educational kits containing a number of activities to teach and educate middle school students on aspects of light pollution, such as “what is light pollution?” and “when does light become pollution?” are available, but only two exist in Australia.

There are wide-ranging benefits available to the population when night skies are preserved. An effective means to influence government policy on all levels is to regularly inform of the economic, health, educational, psychological, emotional, spiritual, cultural, etc, benefits that arise.

The number of areas worldwide that have received, or have applied for, IDA accreditation on the gold or silver level is very encouraging. Dark Sky designations to date are:

* 18 Communities,
* 59 Parks,
* 12 Reserves, and
* 3 Sanctuaries,

with designations as defined on the IDA website - <http://www.darksky.org/idsp/>

Influencing Government.

1. Economic.

Local economies gain substantial benefit from tourism. Astro-tourism offers tremendous opportunities to influence government policy towards light at night.

Importantly, sustaining quality night skies does not depend on eliminating outdoor lights in the surrounding area, but on having intelligently designed and installed fittings that prevent light spill into the sky. Good design incorporates luminaires of appropriate brightness and of warm colour temperature that minimises horizontal scatter. These criteria were shown to be effective in maintaining night sky values at Mt John, NZ. Dark sky accreditation, the prestige gained and the desire to maintain sky quality are all important in preserving quality night skies in the long term. However, as development inevitably occurs in the area, constant vigilance in ensuring compliance of new and existing outdoor lighting is required.

Mt John Observatory, NZ, a gold-tier International Dark Sky Reserve (IDSR) and the first in the world to receive gold-tier status, currently attracts 200,000 tourists per annum for astro-tourism to enjoy its pristine skies and beautiful landscape. The facility has wide support from local government and community, and the economic benefits to the region are clear and sustainable.

Astro-tourism to the Warrumbungles silver-tier IDSR is growing. In a bottom-up strategy astro-tour operators actively encourage accommodation providers to become more night-sky friendly by favouring establishments that have improved their lighting management. It’s natural that the economic lever will encourage other operators to follow suit. With clear evidence of the economic benefits afforded by astro-tourism, local government would be encouraged to actively improve lighting practices in their area of responsibility, to retain and hopefully enhance sky quality to sustain the economic benefits.

1. Health.

Human and ecological health are other significant levers to influence government. Over the past decade indisputable evidence has been published about the adverse effects of (blue) light at night on human health. It is clear that circadian rhythm - the body’s internal clock - and melatonin secretion are strongly affected by (blue) light at night. Indeed, in 2017 Hall, Rosbash and Young won the Nobel Prize in Physiology or Medicine <https://www.nobelprize.org/nobel_prizes/medicine/laureates/2017/press.html> for their work on molecular mechanisms controlling the circadian rhythm. The clock regulates critical functions such as behaviour, hormone levels, sleep, body temperature and metabolism. Disruption of circadian rhythm and melatonin secretion by (blue-rich) light at night has been implicated as a factor in rising incidence of diseases such as, cancer, depression, obesity, and many others. The American Medical Association has published a policy document addressing the hazards to human health of blue-rich LED streetlights, but the policy did not extend to such LEDs in the home. Their policy has been criticized by the vested interests of the lighting industry.

In Australia many streetlight luminaires are 4000K (cold white, too blue-rich), but adopting a maximum of 3000K (warm white) for night use must be encouraged. In Europe luminaires having colour temperatures of 2200K are being adopted. These have effectively no blue content, have minimal glare and there is less scattering by the atmosphere - good all round for health, visibility and the sky.

The Australian Medical Association has been strangely silent. Anecdotal evidence presented, admittedly from a small sample, indicated that medical practitioners had very little interest in the subject. This needs to be addressed as a matter of urgency. A government’s prime responsibility is to safeguard the health of the community and the introduction of overly bright, blue-rich, LEDs for street lighting may be storing up community health issues in the future. An opportunity exists to engage high profile science presenters or medical scientists to speak up about the proven dangers and to elicit a response from the Australian Medical Association. An aware public informed through media debate is in position to pressure government, at all levels, into acknowledging the problem of light at night and into taking positive action.

Maintaining quality skies for people to enjoy provides benefits to humans on all levels, psychological, spiritual, emotional and cultural. Individuals experiencing, possibly for the first time in their lives, a natural day-night cycle and the sky at night may benefit from a heightened sense of relaxation and lower stress and feel the link to a more natural situation.

1. Compromise.

Observatories in all cities and towns are impacted by light pollution. Sydney Observatory (SO) is no exception. Located close to the centre of the most light-polluted city in Australia the impact of light on its operations is considerable. Over the past 20 years SO and Sydney’s night sky have been under constant attack from lighting designers intending to illuminate structures. Several examples were presented; one cogent example was an intention to project 71,000W of light upwards onto the narrow pylons of a bridge and another was to floodlight the highly reflective surfaces of a tall office building. Objections raised on the anticipated impact on SO and on the amenity of residents were acknowledged by the City of Sydney which wisely refused the second plan. Ironically, 18 years on, the lights are still in place, but have never been used. It is disturbing to realise that light pollution from Sydney is a concern to Siding Spring Observatory which is over 400km away.

An example of good lighting was Sydney Town Hall where low wattage lights are directed downwards or shielded from spilling upwards. In one other example, through discussions with the designer and compromise, the effectiveness of upwards illumination of a tubular geometric structure was improved by lowering the wattage and by using more tightly focussed beams. Through discussion with designers, media reporting and compromise, the effects on the sky of what we consider to be unnecessary illuminations at night can at least be minimised. The clear message was “don’t give up”!

It is noteworthy that the scientific value of two of the foremost observatories of the 20th Century, Mt Wilson and Mt Palomar, have been seriously degraded due to uncontrolled development of Los Angeles and San Diego, respectively, and their environs and careless illumination at night.

We need people with scientific backgrounds to visit local groups such as Rotary meetings and schools to inform the community about light at night.

The dogma that lighting at night provides security against crime needs to be constantly challenged. To the contrary the evidence suggests that crime rates are no worse, or are slightly lower, when lights are turned off at night. There are logical reasons - anecdotally, the Police are of the same opinion - that light at night does not reduce crime. On-line crime statistics might be used as evidence to mount a case.

Professor Brian Cox is presenting Stargazing Live on the 23rd May. The opportunity may exist to engage him in the problems arising from light pollution and blue-rich light at night. (Probably too late for 2018 as most of the show segments have been pre-recorded.)

Key Strategies/Outcomes:

* Governments listen and take action if they see a clear benefit to them
* Astro-tourism and its economic benefits are powerful levers for action at all levels: individual (business) through to government
* Medical research has strong, clear evidence that the health of human (and wildlife) is seriously affected by (blue-rich) light at night.
* There is an urgent need to engage science presenters and medical practitioners to educate the community and government about the importance of circadian rhythm to human health and the dangers of blue-rich light.
* “Don’t give up” when illuminated structures are planned in your light-polluted city. Make an objection, provide valid arguments and be willing to compromise to reduce light directed into the sky. Designers will listen.

Sincere thanks go to Judith Bailey (Secretary IDAVic) for organising the symposium and venue and to Robert Wagner for recording the proceedings.

*Dr Russell Cockman*

IDAVic President

April 2018.

**Appendix**

**Dark Sky Symposium 2018 Program**

 **9:00 -9:15 Reception
 9:15 - 9:30 Welcome Dr Russell Cockman President IDAVic and Chair**

 **9:30 - 10:00** **Planetary Illuminations** **Marnie Ogg**

Abstract:

For the past 11 years, Marnie has been masterminding Fred Watson Tours, a travel company dedicated to bring science and tourism together. With her partner, astronomer Fred Watson, Marnie has taken over 600 people to see observatories, the Aurora Borealis and other wondrous corners of the globe. During her travels she has come to realise something so special and unique to Australia, she helped create a designated park to it: Darkness. During this fully illustrated talk, Marnie reflects on Australia's First Dark Sky Park in the Warrumbungles and other successful night sky ventures around the world and discusses ways you too can help preserve the night sky.

**10:00-10:30 Dimming Sydney’s sky: early efforts to fight light pollution in the city** **Dr Nick Lomb**

Abstract:

Sydney Observatory’s fight against light pollution began in April 1994 when the floodlighting of the concrete sides of the nearby aap building was switched on. The 190-metre tall skyscraper was just 500 metres away from the Observatory and its light was a serious disruption to public evening viewing sessions. In this talk Nick, the former curator at Sydney Observatory, tells of battles over this building and over other buildings that caused similar concern in subsequent years. With assistance from the like-minded members of the Sydney Outdoor Lighting Improvement Society (SOLIS), some notable successes were achieved.

After obtaining a PhD in astronomy from the University of Sydney, Nick joined Sydney Observatory as a research astronomer. A few years later when the Observatory came under the auspices of the Museum of Applied Arts and Sciences, he was appointed as Curator of Astronomy. Trying to preserve the environment of the Observatory from increasingly bright city lights gradually assumed an increasingly important part of his role. Nick left the Observatory in 2009, after 30 years there, to move to Melbourne. He now researches the history of Australian astronomy as well as continuing to prepare the annual Australasian Sky Guide.

**10:30 - 11:00 Morning tea**
 **11:00 - 11:15 Case Study - Ongoing Awareness Campaign and Ballarat Sky Quality Survey Judith Bailey**

Abstract:

Over a number of years light pollution levels have been measured in a number of locations around Ballarat. Some of the positive gains from the considerably long campaign on the light pollution issue have resulted in increased Community awareness and generational long term achievements.

Judith Bailey Joined the Ballarat Astronomical Society in 1985 and the ASV in 1995 and is currently the Manager of the Ballarat Observatory and has had an interest in Light pollution issues since 1988. Working with the late Geoff Dudley (ASV) a Sky Quality Meter was used to start a Survey of lighting levels around Ballarat.

**11:15 – 12:00pm Workshop**
**'How to influence government’, ‘How to get the dark sky message to the public’, 'Next Steps'.**

**12:00 - 12:30 Melbourne Light Pollution - What of the Future? Dr Barry Clark**

Abstract:

Artificial skyglow brightness measured in the northern suburbs of Melbourne is well below exponential growth predictions made two decades ago.  Regardless, deep-sky observers keep complaining that nebulae are still getting harder to see.  The most plausible explanation is that the overall correlated colour temperature of lighting is rising as a result of the widespread adoption of LEDs that rely on blue-stimulated fluorescence.  For a given photopic level of skyglow, visibility of faint low-contrast celestial objects will be most affected by artificial skyglow with a high correlated colour temperature, ie blue-rich skyglow.

It is mainstream science that the blue content of ambient artificial light at night carries health risks for humans and is a major biodiversity threat.  Some sections of the community are campaigning for change but the majority appears to be unaware and unconcerned.  Blue light emission at night should be reduced greatly.  It would be helpful for indoor lighting in daylight hours to be bright and blue-rich, and at night, dimmer and blue-poor.  Reduced lighting at night is more likely to result in crime reduction than crime increase.

Barry Clark joined the Astronomical Society of Victoria in 1955 and is an honorary life member. His research career in defence science and technology (1959-1996) was in the fields of optics and vision. He was the founding Director of the ASV’s Outdoor Lighting Improvement Section nearly two decades ago.

**12:30-13:30pm Lunch**

**13:30-14:00 Measuring the Night Sky Brightness and Instructional Kit on Light Pollution Mike Chapman**

Abstract:

To amateur astronomers, light pollution is something that is obvious.  To others light pollution is a concept that comes with many loaded ideas and issues.  To understand and work with controlling light pollution we need to quantify what light pollution is and when light does become pollution.  To this end during the International Year of Light, a number of academic organisations researching in light banded together to produce an educational kit on light pollution.  This kit involves a number of activities to teach and inform on aspects of light pollution.  Whilst primarily designed for middle school students it is equally suitable for the general public and anyone else for that matter.

The pervasive problem of light pollution is that it is wide spread, light pollution follows urban development.  Whilst some dark sky locations and astronomical observatories have programs to measure light pollution for the majority of amateurs that live in towns and cities their answer to light pollution is to attempt to restrict it.  A number of citizen science programs exist to monitor light pollution - Australia is poorly represented in these efforts.  The importance of this data is that it can be used to correlate satellite data and images from the International Space Station and used to formulate policy on lighting issues.  A short review of these programs and how to participate will be presented.

Michael is a long time amateur astronomer. He has a long time association with the Sydney City Skywatchers and has been awarded Life Membership of the association. He also is a founding member of Sydney Outdoor Lighting Improvement Society (SOLIS). His interest in astronomy led to involvement in challenging issues with lighting and is a recent graduate from Sydney University with a Masters in Architectural Studies (Illumination Design) and is pursuing further research in light pollution.

 **14:00-14:30 The Aoraki Mackenzie International Dark Sky Reserve Professor John Hearnshaw**

Abstract:

The Aoraki Mackenzie International Dark Sky Reserve (AMIDSR) is the world's largest dark sky reserve at 367 sq km. It is in the central South Island of New Zealand and was created in 2012 with accreditation from the International Dark Sky Association. It was the first IDSR in the southern hemisphere, the first in the world to be accorded gold tier status and the third in the world to be recognized. I will describe the creation of the reserve, its management, its activities and the strong impetus to astro-tourism it has provided. About 200,000 tourists a year now to see the pristine starlit skies of the Mackenzie District.



John Hearnshaw was born in Wellington in 1946, with an English father and Aussie mother, but I grew up in the NW of England from 1948 after my father got a job there after the war. My education was in the UK where I lived for 19 years, but after graduating from Cambridge with a science degree in 1967, I did a PhD in astronomy at the Australian National University in Canberra from January 1968. I married Vickie, a Kiwi girl, in the middle of my doctoral work in December 1969 (we met in Panama when I sailed on a P&O liner from the UK in 1967). After finishing a doctoral thesis I had two short research fellowships, the first at the Paris Observatory (1972-74) and the second one at Harvard and the Smithsonian Institution in Cambridge, Mass (1974-76). In 1976 I returned to New Zealand to a lecturing position at the University of Canterbury. I was promoted to a professorship at Canterbury in 1995 and eventually retired in 2014 after 38 years. For 25 of those years I served as director of Mt John Observatory at Lake Tekapo, in three different periods. I spent a lot of time developing new instruments to use at Mt John and training graduate students in astronomy (PhD and MSc). During my time at Canterbury I wrote six books on astronomy, most of them on the history of stellar astrophysics in the last 200 years. I have also been active working for the International Astronomical Union (and still am); the IAU is the society for professional astronomers with about 12000 members world-wide. From 2003 to 2012 I chaired the IAU Program Group for the World-wide Development of Astronomy, a job that entailed travelling to developing countries to give lectures, to advise on teaching astronomy and to promote research collaborations. My travels took me to Mongolia, Cuba, Venezuela, Uzbekistan, Tajikistan, Mauritius, Fiji, North Korea, Uruguay, Paraguay, Trinidad and Tobago and Thailand.

**14:30- 15:00pm The River Murray Dark Sky Reserve (RMDSR)** **Andrew Cool**

The scientific data acquired in the last 18 months at the River Murray Dark Sky Reserve (RMDSR) and about the project generally. Andrew, with the RMDSR team, has made extensive SQM readings in the RMDSR and modeled atmospheric and cloud conditions with all-sky cameras in the region. He has extensive experience in this field working for DSTO. RMDSR are awaiting a decision from IDA for accreditation for the RMDSR - hopefully Gold standard.

**15:00 – 15.05pm Closing Remarks Dr Russell Cockman**

**15:05pm Afternoon Tea**

 **15:30pm Tour of the Observatory and Museum**